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AUTHOR Levande, James S.; Glaser, Roberta; Henrion, Al; Kruyer, Richard; Schmitt, Laurie; Woodman, Deborah

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ABSTRACT

Michigan's curriculum framework is a resource for helping the state's public and private schools design, implement, and assess their content area curricula against state and national content standards. The framework emphasizes the following: using continuous school improvement to align all school district initiatives to increase student achievement; building a curriculum based on rigorous content standards and benchmarks; using student achievement data to make decisions about school improvement, curriculum, instruction, and professional development; and incorporating research-supported teaching and learning standards into daily instructional practice. Technology education fits into the curriculum framework through two initiatives: the Michigan Technology Content Standards and Benchmarks and the Michigan Technology Education Curriculum Guide, which advocates the use of a portfolio ("techfolio") process to guarantee students' engagement with the four standards of authentic learning. Other indirect initiatives that support and complement the framework are as follows: technology education teacher certification standards; teacher preparation standards for technology education teachers; and technology education as a component of and channel to career preparation programs. Technology education teachers participated in the initiatives as members and representatives of the Michigan Industrial and Technology Education Society, the state International Technology Education Association affiliate, and the Learning Institute for Technology Education. (MN)

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TECHNOLOGY EDUCATION INITIATIVES and STATEWIDE CURRICULUM INTEGRATION in MICHIGAN

Dr. James S. Levande, Michigan Department of Education, Lansing, MI
Dr. Roberta Glaser, St. Johns Public Schools, St. Johns, MI
Mr. Al Henrion, Pinconning Area Schools, Pinconning, MI
Mr. Richard Kruyer, Grand Blanc Community Schools, Grand Blanc, MI
Ms. Laurie Schmitt, Ottawa Intermediate School District, Holland, MI
Ms. Deborah Woodman, Lansing Public Schools, Lansing, MI

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MICHIGAN TECHNOLOGY EDUCATION

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Contact:
James S. Levande, Ph.D.
Office of Career and Technical Education
Michigan Department of Education
P.O. Box 30009
Lansing, MI 48909-7509
517-373-6731 (Voice)
517-373-8776 (Fax)
levandej@state.mi.us (E-mail)

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Introduction

Technology Education faces many challenges and opportunities in its goal to develop technologically literate and capable students. This presentation describes the part Technology Education plays, within the general education system, in supporting and enhancing Michigan's statewide curriculum framework to achieve this goal.

We would like to show you how we fit the various components of our state's educational system together to make Technology Education a vital and active contributor to the development of life-long technological abilities for all students.

Our aim is to provide you with how:

- the Michigan Curriculum Framework, as the structure for the state's curriculum content and delivery,
- the state standards and benchmarks for Technology,
- Technology Education initiatives,
- the state career preparation system, and
- the state ITEA affiliate and other Technology Education professional groups

fit into the overall scope of education and how they complement and synergize teaching and learning about technology.

Michigan's Curriculum Framework

The framework is a resource for helping Michigan's public and private schools design, implement, and assess their content area curricula. The framework includes the resources needed to develop a standards-based curriculum.

The framework emphasizes the importance of:

- using continuous school improvement to align all school district initiatives for the purpose of increasing student achievement;
- building a curriculum based on rigorous content standards and benchmarks;
- using student achievement data to make decisions about school improvement, curriculum, instruction, professional development; and
- incorporating research-supported teaching and learning standards into daily instructional practice.

The goal of the framework is to improve student achievement by aligning classroom instruction with state and national content standards. It is designed to be used as a process for the decision-making that guides school improvement. It describes curriculum,

instruction, assessment and professional development and focuses on improving program quality by ordering all the processes that affect student achievement.

Standards and benchmarks for:

English Language Arts
Mathematics
Science
Social Studies
Arts Education
Career and Employability Skills
Health Education
Life Management Education
Physical Education
Technology Education
World Languages

are the foundation of the framework.

The framework models the processes of planning and development, teaching and learning, assessment, and professional development for the achievement of the standards and benchmarks. It emphasizes the continuity of K-12 curriculum. It does not provide a "cookbook", uniform approach to all situations and locations. It requires local districts to engage in the processes in order to meet their needs and reach their goals while ensuring the achievement of the standards and benchmarks.

The planning and development part of the framework is aimed at a district's customization of the school improvement process. It is intended to help districts combine the processes they are using for programs such as accreditation, Title I, and career preparation and align instruction and assessment with all content areas.

The teaching and learning portion of the framework provides standards for authentic instruction (Newmann, et al, 1995) and illustrates how these standards are met through instructional decision-making and practice. The authentic instruction standards are:

- Higher-Order Thinking
- Deep Knowledge
- Substantive Conversation
- Connections to the World Beyond the Classroom.

Vignettes are used to illustrate how teachers might incorporate the standards for authentic

instruction into their teaching units and design instructional experiences which help students develop the knowledge and abilities identified in the standards and benchmarks.

The assessment piece deals with the broader issues which should be considered by a district as they develop a local assessment system, how a teacher might assess when their students have reached a level of proficiency relative to the content standards, and guidelines for developing the local components of a total assessment system. The approach is holistic in that it requires considering the needs of various organizational levels from the student, through the classroom, school building, and district levels, and on through to regional, state, and national levels. A set of standards for assessment tasks is provided to judge the degree to which the task is both a powerful and authentic performance that represents a concrete connection to the subject content standards. These standards for assessment are:

- Organization of Information
- Consideration of Alternatives
- Disciplinary Content
- Disciplinary Process
- Elaborated Written Communication
- Problem Connected to the World Beyond the Classroom
- Audience Beyond the School.

Examples of scoring guides are provided and linked to the instructional vignettes in the teaching and learning part of the framework. In addition characteristics of a good local assessment are given to assist in developing and aligning assessment for the purposes of all the stake holders - students, parents, teachers, administrators, and policy makers.

The professional development part of the framework highlights the idea that professional development is systemic, contextual, and intellectually rigorous. It emphasizes that the process, context, and content of professional development must shift away from event-centered approaches to professional learning and must be aligned with school improvement, curriculum, instruction, and assessment. The standards for professional development are the same ones used for authentic instruction to students - deep knowledge, higher-order thinking skills, substantive conversation, and making connections. Models of professional development and steps for designing a comprehensive professional development plan are provided. The models are:

- Individually Guided
- Observation/assessment
- Involvement in a Development/Improvement Process
- Training
- Inquiry

The steps for designing a comprehensive plan include assessing professional needs, developing district, building, and personal professional development plans, implementation, providing time, resources and follow-up, evaluation, and refinement and reinvention.

These things - planning and development, teaching and learning, assessment, and professional development - make up the curriculum framework. When they focus on the achievement of the standards and are truly applied and integrated into the education endeavor they provide a platform for student success.

Michigan's Technology Education Initiatives

Technology Education fits directly into the curriculum framework through the following initiatives:

- the *Michigan Technology Content Standards and Benchmarks*, the foundation for a standards-based approach to teaching and learning; and
- the *Michigan Technology Education Curriculum Guide*, which provides the framework structure for planning and development, teaching and learning, assessment, and professional development in the field of Technology Education.

Other indirect initiatives, which support and complement the framework are:

- Technology Education teacher certification standards,
- teacher preparation standards for Technology Education teachers, and
- Technology Education as a component of and a channel to career preparation programs.

Technology Content Standards and Benchmarks Michigan's Technology Content Standards and Benchmarks address the need to ensure that all of our state's students become technologically literate. Professionals, representing the multiple facets of teaching about and using technology, drafted the standards and benchmarks. Public review input and Technology Education Referent Advisory Group recommendations were used to confirm the standards and benchmarks . The standards are focused on developing technological literacy K-12 and cover Technology Education and instructional technology.

The standards vision statement states that . . .

> Technology is the systematic application of knowledge, materials, tools, and skills to extend human capabilities. A technology curriculum integrates the complementary areas of Technology Education and instructional technology. Technology Education is the study of

technology and its effects on individuals, society and civilization. Instructional technology is the application of technology to the teaching/learning process.

Learning with and about technology prepares learners to live responsibly in a democratic, technically driven society. Learners will use technology for knowledge and skill acquisition, communication and information management, problem solving, creative expression, research, design, and product development. Learners become technologically capable when they apply technology across curricular areas and when technology is used throughout the learning process.

This vision is clearly set forth in the standards themselves. The standards are . . .

All students will:

1. use and transfer technological knowledge and skills for life role (family member, citizen, worker, consumer, life long learner);

2. use technologies to input, retrieve, organize, manipulate, evaluate, and communicate information;

3. apply appropriate technologies to critical thinking, creative expression, and decision-making skills;

4. employ a systematic approach to technological solutions by using resources and processes to create, maintain, and improve products, systems, and environments;

5. apply ethical and legal standards in planning, using, and evaluating technology; and

6. evaluate the societal and environmental impacts of technology and forecast alternative uses and possible consequences to make informed civic, social, and economic decisions.

The benchmarks provide indicators of student expectations at various developmental levels including early elementary, later elementary, middle school, and high school. They describe the expectations in terms such as "demonstrate", "use", "design", "construct", "compare/contrast", "analyze", etc. By using such language parents, teachers, and others will be able to observe the appropriate indicator in student actions and products. An example of a benchmark is provided in Figure 1. This benchmark is one that addresses the fourth technology standard - the standard that focuses on using a systems approach in solving problems.

Figure 1. Example Benchmark

Standard 4 - Systematic Approach			
Technological Products & Systems			
Early Elementary	**Later Elementary**	**Middle School**	**High School**
Create a simple quality prototype using appropriate tools, materials, equipment, and processes to solve a given technological problem.	Design/redesign a quality technological prototype to meet a societal or environmental problem.	Design/redesign a quality technological prototype to meet a societal or environmental need using investigation, analysis and idea development, proposals, planning, making a prototype of the solution, testing and evaluation of the prototype, and self assessment.	Adapt solutions to the needs and values of individuals, groups, society, and environment when designing/redesigning problem solutions and creating a quality end product to meet the need.

The standards and benchmarks provide the content and context for the four main segments of the curriculum framework - planning and development, teaching and learning, assessment, and professional development.

Michigan Technology Education Curriculum Guide The curriculum guide was developed to help students achieve technological literacy as stated and described in Michigan's Technology Standards and Benchmarks. Its purpose is to provide direction to local schools and communities in developing, implementing, and improving Technology Education as an area of study in grades K-12.

The guide furnishes direction as opposed to the solutions for meeting community and school needs. The guide's users must collaborate and work together to make determinations about achieving the Technology Standards and Benchmarks. Students, parents, teachers, administrators, and policy makers are encouraged to use the guide's content as a structure to plan and deliver Technology Education and gauge or measure the achievement of technological literacy. It is expected that the who, what, where, and when questions must be answered in the community and its schools.

Because a Technology Education curriculum does not stand alone, the guide's users are asked to use additional materials and information in conjunction with the guide. One of these additional items is *Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA, 1996). It is pointed out that the use of all available information will enable schools to develop a truly comprehensive curriculum in which all learners will achieve success.

The guide advocates four criteria for successful curriculum:

- knowledge about the needs and abilities of the students to be served,
- information about available human and material resources,

- collaborative processes for curriculum development and school improvement, and
- proactive attitudes related to achieving change.

The guide considers these items as the minimum essentials because the development of a Technology Education curriculum demands a continual fostering of collaboration, positive approaches, and the development of information and resources.

Primarily the guide is a communication tool. The state framework serves to provide the primary direction to professionals in Michigan who are seeking definitions, applications, and measures of success. The *Michigan Technology Education Curriculum Guide* focuses the framework process by furnishing the specifics in the contexts, knowledge, and processes of Technology Education.

The *Michigan Technology Education Curriculum Guide* format and content parallels the state framework with the inclusion of sections on the standards and benchmarks, teaching and learning, student assessment, and professional development. It also includes a rationale for the study of Technology Education in Michigan, a model for program assessment, and a glossary of terms related to Technology Education, curriculum development, and career preparation.

The guide advocates the use of a portfolio process to guarantee the student's engagement with the four standards of authentic learning. The guide refers to the portfolio as a "techfolio" as a way of communicating the importance of integrating the framework's learning standards with the practices of Technology Education.

A techfolio requires the learner to approach every Technology Education activity in an organized, systematic fashion. It channels and challenges students to use and apply the knowledge they are learning and the abilities they are developing to solve real-world problems and conduct relevant investigations. It demands and focuses the use and application of mathematical, English language arts, science, and social science knowledge and skills to technological problem solutions.

Figure 2 provides a match up between the systems model and the techfolio components. The guide provides techfolio formats that match the benchmark levels - early elementary, later elementary, middle school, and high school - so that students and teachers can approach the problem solving process at the appropriate levels of teaching and learning.

Figure 2. Technology Systems Model Components & Techfolio Areas

SYSTEMS COMPONENTS	*TECHFOLIO AREAS*
INPUT (Desired Result)	**Introduction** of theme, question, issue by the teacher.
	Design Brief presented by the teacher and rephrased and rewritten by the students.
	Problem Statement developed by the students.
PROCESS	**Problem Limitations**, specifications, parameters, constraints and other conditions developed by the students and facilitated by the teacher.
	Research and Investigation by the students to obtain information that will be used in solving the problem.
	Possible Solutions/Ideas/Proposals developed by the students.
	Selection of Best Solution/Idea/Proposal by the stude.../ in consultation with the teacher.
	Planning by the student, including drawings, material and equipment requirements, and directions for making, building, construction, and development.
	Making/Building/Constructing/Developing the product or service by the student and facilitated by the teacher.
OUTPUT (Actual Result)	**Testing/Evaluating the Product or Service** by the student to make comparisons with the defined solution.
	Presenting the Product or Service by the student to peers, the school, and community.
FEEDBACK	**Feedback** by the student to describe the similarities and differences between the desired result with the actual result and the input from peers, school, and community.

The techfolio's linkages to and application of student skills and abilities from mathematics, English language arts, science, and social studies creates a fusion of subject matter and emphasizes the interconnectedness of human activity. Students are encouraged to draw on the knowledge, principles, and practices of these curricular areas and make applications to the technological problem solving activity as a matter of course. In this way connections to the world beyond the technology lab/classroom are made and assimilated.

The techfolio facilitates assessment in that it provides:

- a means to observe and measure student technological proficiencies at points along the way to problem solutions,
- a means to observe and measure the application of the basic academic skills and subject matter linkages to mathematics, English language arts, science, and social studies,

- a culminating assessment of the entire problem solving process and the problem solution itself,
- a means for student self-assessment, as well as teacher assessment, and
- a means document the technological and basic subject matter proficiencies of the student.

To accomplish this type of assessment the guide recommends establishing, describing, and scaling student proficiencies based on the indicators in the benchmarks at the outset of all Technology Education teaching. These "rubrics" then serve as a means for students and teachers to communicate about the processes involved in and the final product of the learning activity. There is the added advantage in that developmentally appropriate rubrics for related learning in other subject areas can be associated with and applied to the Technology Education learning activity. An example of a rubric and its language is provided in Figure 3. The scaling or point structure for the rubric is provided in Figure 4.

Figure 3. Sample Rubric for Student Assessment

PARTIALLY PROFICIENT	*PROFICIENT*	*ADVANCED*
• develops a partially adequate investigation and analysis strategy	• uses an investigation and analysis strategy to develop the product and processes	• uses multiple ways of investigation and analysis to develop the product and processes
• uses minimal information technology to gather information	• uses primary information sources to determine and assess possible solutions to the given problem	• uses a variety of information sources, including little known sources, to determine and assess possible solutions to the given problem
• documentation of information sources is incomplete	• documents and uses gathered information to select a solution	• documents and uses gathered information to select a solution
• the plan does not include all the required industrial tools, materials, equipment, and processes to achieve the selected solution	• develops a plan that incorporates industrial tools, materials, equipment, and processes to achieve the selected solution	• identifies the need of a specific individual, group, society, or environment and adapts the plan to achieve the selected solution to meet the identified need
• the product and processes are partially completed	• produces the product and processes using industrial tools, materials, equipment, and processes	• produces a particularly high quality product and processes using industrial tools, materials, equipment, and processes
• tests and evaluates the product and processes using at least one predetermined criteria	• tests and evaluates the product and processes using criteria developed as part of the planning process	• involves the individual or group associated with the identified need in the product and processes test and evaluation
• the technological system does not display improvement	• the technological system displays continuous improvement	• the technological system displays continuous improvement

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Figure 4. Rubric Scaling for Assessment

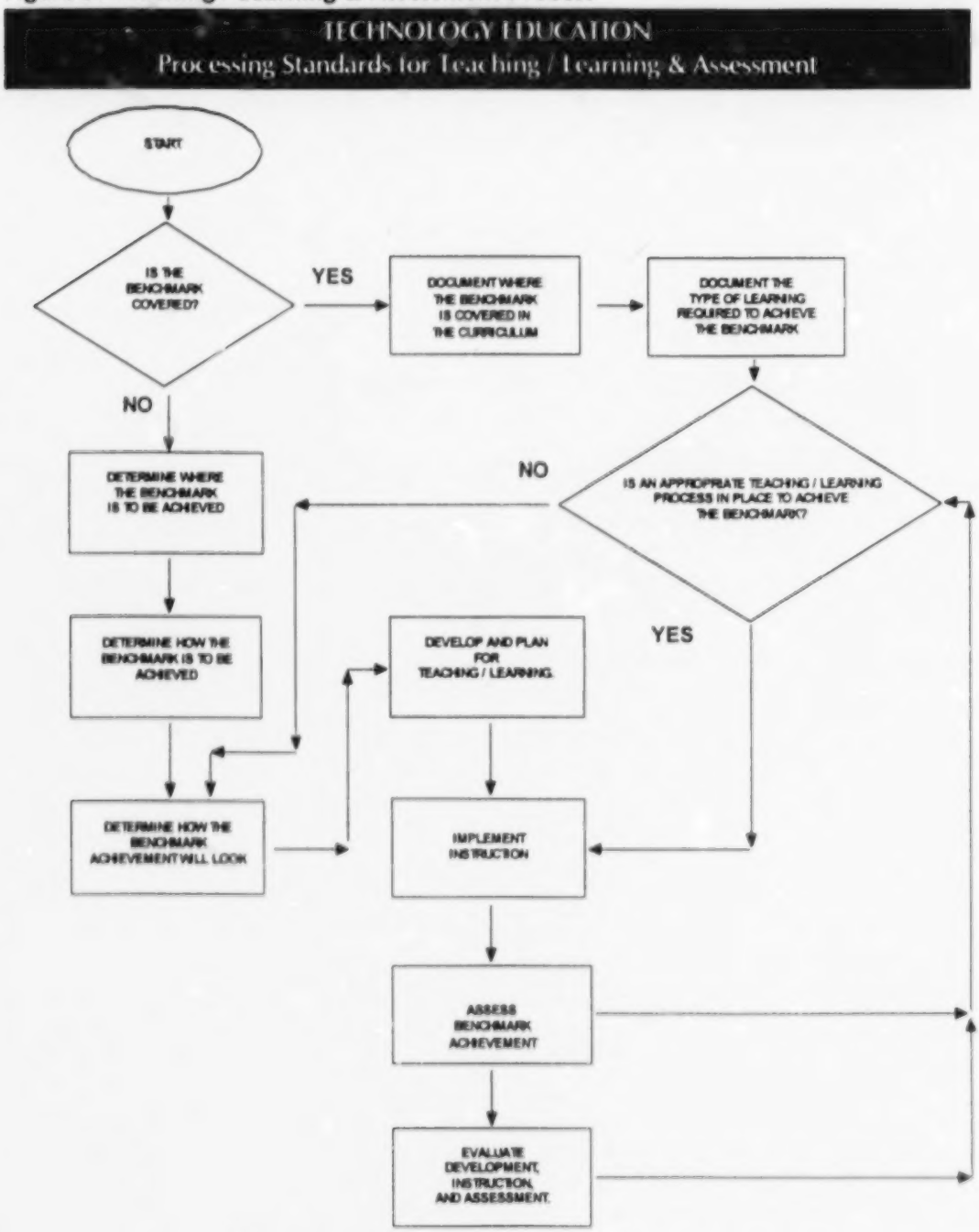
POINTS	*LEVEL*	*GENERIC DESCRIPTION*	*SPECIFIC EXAMPLE* Standard 4 - Systematic Approach Processes Middle School
4	Advanced	The student goes beyond the knowledge or activity described in the standard/benchmark. This can be in quantitative and/or qualitative ways and by meeting standards/benchmarks at the next level.	. . . produces a particularly high quality product and processes using industrial tools, materials, equipment, and processes.
3	Proficient	The knowledge or activity described in the standard/benchmark is demonstrated or performed by the student.	. . . produces the product and processes using industrial tools, materials, equipment, and processes.
2	Partially Proficient	The knowledge or activity described in the standard/benchmark is demonstrated or performed in part.	. . . the product and processes are partially completed.
1	Beginner	Some knowledge or activity described in the standard/benchmark is attempted by the student.	. . . an attempt is made to produce the product and processes.

The integration of planning and development, teaching and learning, and assessment for the framework's standards-based approach is diagramed in Figure 5.

The guide also includes a program assessment process for assisting planners, developers, practitioners, and policy makers to use as they go about the business of school improvement that relates to Technology Education and the total school curriculum. The elements of this process require matching existing content and practice to the content standards, teaching, learning and assessment standards, and professional development standards of Technology Education and the entire schooling process. Stress is placed on collaborative and collegial activity to achieve program goals and success.

The final major section of the guide addresses professional development. It provides a rationale and structure for moving professional development away from an event centered activity to a continuous process model which takes into consideration the standards-based approach to teaching and learning, organizational goals and processes, and teacher professional goals. In many respects this area is key to accomplishing the goals of Technology Education and the school curriculum. Here again collaborative action is necessary to obtain the desired ultimate result of the educational process - student success. The guide describes standards and approaches that are appropriate for continuous development and improvement. Its final message is to the teachers of Technology Education. This message stresses that teachers step forward and become involved in the

Figure 5. Teaching / Learning & Assessment Process


TECHNOLOGY EDUCATION
Processing Standards for Teaching / Learning & Assessment
START
IS THE BENCHMARK COVERED?
YES
DOCUMENT WHERE THE BENCHMARK IS COVERED IN THE CURRICULUM
DOCUMENT THE TYPE OF LEARNING REQUIRED TO ACHIEVE THE BENCHMARK
NO
DETERMINE WHERE THE BENCHMARK IS TO BE ACHIEVED
NO
IS AN APPROPRIATE TEACHING / LEARNING PROCESS IN PLACE TO ACHIEVE THE BENCHMARK?
YES
DETERMINE HOW THE BENCHMARK IS TO BE ACHIEVED
DEVELOP AND PLAN FOR TEACHING / LEARNING
DETERMINE HOW THE BENCHMARK ACHIEVEMENT WILL LOOK
IMPLEMENT INSTRUCTION
ASSESS BENCHMARK ACHIEVEMENT
EVALUATE DEVELOPMENT, INSTRUCTION, AND ASSESSMENT

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teaching, learning, and professional activities of the school community and become spokespersons, supporters, and advocates for a comprehensive approach to student learning and Technology Education's place within this comprehensive approach.

Related Initiatives There are a number of related initiatives which support and complement the curriculum framework and Technology Education. These are certification standards for Technology Education teachers, higher education preparation standards for Technology Education teachers, and the integration of Technology Education into Michigan's career preparation system. Without these initiatives Technology Education would not have a fully function role in developing technological literacy for all learners.

Technology Education Teacher Certification Standards To ensure that Michigan will continue to have high quality teachers to teach Technology Education and to align the technology content standards and curriculum framework with teaching practice a process was initiated to change the state's certification standards. This process involved teachers, professional organizations, teacher educators, curriculum specialists, school and program administrators, and department of education consultants and staff. The final result was the state board of education's approval of the creation of a new certification endorsement, named *Technology and Design*, and a new name and "redefinition" of the former Industrial Arts endorsement. The Industrial Arts endorsement is now named *Industrial Technology*.

Industrial Technology addresses the development of technological knowledge and skills associated with a worker's life role. The focus of the field is to engage learners in activities related to contemporary industrial practices, procedures, and processes. Learners may use the knowledge and skills of Industrial Technology as a foundation for participation in secondary level instruction that prepares them for specific technical careers.

Technology and Design addresses the development of technological literacy for all students. Technological literacy encompasses the ability to use and apply technology, understand the issues raised by the use of technology, and appreciate the significance of technology. The focus of the field is to engage learners in: a) the actions taken in developing, producing, using, and assessing technology, and b) the contexts where technology is developed and used.

Teacher Preparation Standards for Technology Education Upon the approval of the new and revised certifications for Technology Education standards were developed to prepare teachers to be able to acquire the new certifications. Again the process involved teachers, professional organizations, teacher educators, curriculum specialists, school and program administrators, and department of education consultants and staff. The process revised and upgraded state standards and aligned these standards with National Council for Accreditation of Teacher Education standards for Technology Education. All institutions of higher education wishing to recommend (or continue to recommend) candidates for the

Technology and Design or Industrial Technology certificates will be required to submit separate applications for program approval that demonstrate inclusion of the new Technology Education content. Changes of a current Industrial Arts program to an Industrial Technology program must be approved prior to January 1, 2000. After that date Industrial Arts programs will no be viable for preparing teachers of Technology Education in Michigan.

Michigan's Career Preparation System and Technology Education During 1997 Michigan's legislature enacted school laws which revamped how career preparation is funded, developed, administrated, and operated. The legislation makes career preparation and integral part of the state's total educational system and an equal partner in workforce development and economic development systems.

The career preparation system is made up of components that include:

- Academic Preparation
- Career Development
- Workplace Readiness
- Professional and Technical Preparation
- Work-Based Learning
- Accountability
- School Improvement

Technology Education is a foundation piece for academic preparation, career development, workplace readiness, accountability, and school improvement. It provides the basic technological literacy that can serve as a vehicle for student success in developing their personally defined adult roles.

Technology Education's part in the career preparation system is to contribute standards-based instruction by providing: a) practical, beyond the classroom contexts for curriculum integration in the core subjects of mathematics, English language arts, science, and social studies in grades K-12, b) career exploration at middle and high school levels, c) workplace readiness skills, and d) a bridge from general education teaching and learning to specific career and technical education at secondary and post secondary levels. Technology Education serves to focus students on career opportunities in the areas of engineering, manufacturing, industrial technology, information and communications technology, and service technology at less than baccalaureate and college preparation programs for these areas.

The career preparation system recommends and advocates integrating Technology Education into the teaching and learning of the core subjects at the elementary level, providing required exploratory experiences at the middle school level, and providing career pathway instruction for the high school level which will assist students to develop

greater awareness, knowledge, and skills common to careers in engineering, manufacturing, industrial technology, information and communications technology, and service technology. This high school level career pathway instruction will provide some students a useful sequence of experiences leading to more specialized career and technical programs at the later high school level and college bound students with an introductory background for selecting specialized or academic majors at the college level.

Technology Education Professional Organization Contributions

All of these initiatives were accomplished through the active participation of Technology Education teachers. They participated as members and representatives of the Michigan Industrial and Technology Education Society (MITES), the state ITEA affiliate, and the Learning Institute for Technology Education (LITE). Their contributions were made at every step of the process in developing the technology standards and benchmarks, the curriculum guide, the new and revised teacher certifications, and the teacher preparations standards.

The MITES represents Technology Education, industrial technology, and trades and industries K-12 and post-secondary teachers in our state. The society's mission is to serve the needs of teachers and students in Technology Education at all levels. It accomplishes this mission through publications, and annual statewide conference, and yearly regional and statewide student awards competitions. The MITES leadership appointed members who served in advisory, writing, and reviewing roles for all the initiatives.

LITE is a Michigan non-profit professional organization focused on the professional development of all teachers who teach or incorporate Technology Education in their classrooms. Its membership is made up of K-12 Technology Education and general education teachers. LITE serves the needs of teachers and students through two statewide conferences each year and an awards program which recognizes teachers for their outstanding Technology Education teaching practices and exemplary curriculum innovations. LITE members served in advisory, writing, and reviewing roles for all the initiatives.

LITE and MITES brought a broad perspective of viewpoints to the process in developing all of the Technology Education initiatives. It would have been impossible to achieve such a comprehensive approach without these perspectives. And, in the case of the teacher certification initiative it significantly reduced the time line of the process.

One additional point should be made about the participation of the people in these organizations. They portrayed the type of professional behavior reported in the research describing successful approaches to school improvement, professional development, curriculum development processes, and classroom instruction. They were committed, proactive, and task oriented. By modeling this ideal behavior they provided an example

for the state's Technology Education community and set a standard for others to follow.

Summary

When we started this presentation we spoke about Technology Education's challenges and opportunities in its goal to develop technologically literate and capable students. We hope that by describing Technology Education's role within Michigan's education system we have pictured the ways and means of confronting the challenges and taking advantage of the opportunities.

By fitting the various components of our state's educational system together to make Technology Education a vital and active contributor to the development of life-long technological abilities for all students we believe that we have enhanced the visibility of the contributions that Technology Education makes in the development of competent learners and how the initiatives complement and synergize teaching and learning about technology across the entire school program.

And, finally, we hope that we have demonstrated that these things could not have been accomplished without the active support and participation of the Technology Education professionalism of Michigan.

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